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GROWING

WATERCRESS

LEAFLET NO. 448

U.S. DEPARTMENT OF AGRICULTURE

GROWING WATERCRESS

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Watercress (*Radicula nasturtium-aquaticum*) is a perennial, succulent, leafy plant that belongs to the cabbage family. Although it will grow in wet soil, it grows best in running water. It grows wild in and about springs and clear streams in many parts of the country. For commercial purposes it is grown in unshaded shallow pools of flowing clean water (fig. 1). Most of the commercial production of watercress is located in districts characterized by limestone rock formations and by springs and brooks of clear water relatively high in lime content.

Watercress rates very high as a leafy salad green. It has a refreshing flavor and is high in mineral and vitamin content. It is still a very minor crop, however, with only a few hundred acres of beds supplying the present demand. This does not mean that there is no possibility of profitably expanding the market. Because of its perishability most of the crop is sold either directly to dealers in large cities that have special facilities for handling it or directly to hotels and restaurants. With the recent widespread improvement in facilities for handling fresh vegetables, such as plastic bags and refrigerated and humidified display cases, there should be opportunity for expanding the market for watercress. The possibilities of expanding production are rather limited because of a scarcity of favorable sites, the cost of establishing suitable commercial beds, and the amount of hand labor required in producing the crop.

CLIMATE

Watercress does best in a moderately cool climate but is grown over a wide range of territory from the hilly country of the Southern United States northward to States along the Canadian border. Production is most highly developed in the hilly limestone regions of Virginia, Maryland, and Pennsylvania, where neither the summer nor the winter temperatures are extreme. Winter supplies are grown in the South and summer and autumn supplies to the North. The submerged

portion of the plant will survive during the winter as long as the water surrounding it does not completely freeze. Commercial production during winter weather is dependent not only upon keeping the plants from freezing but also upon maintaining an air temperature immediately above the water surface high enough to promote growth. Air temperatures immediately above the water surface will be dependent upon the temperature and volume of water emerging from the spring and upon the surrounding air temperature.

WATER SUPPLY

The first and most important requirement for commercial growing of watercress is a large supply of water that is pure enough for drinking. Springs in limestone regions with a flow of from several hundred to several thousand gallons of water per minute are the best source of water.

Watercress obtains nitrogen from the water in which it grows. Spring waters vary in nitrate content from 0 to 20 parts per million of water or more. The number and size of beds that a given source of water will support depends to a large extent upon the nitrogen content of the water. The higher the nitrogen content, the smaller the flow needed for a given size bed. The water should contain over two parts per million of nitrate even from the larger springs while smaller springs must contain higher levels to support profitable beds. The vigor of wild watercress in or below a spring gives some idea of the

Watercress is a year-around delicacy. It is shipped to the principal city markets all over the country. There is a continuing demand from gardeners and others for information on the growing of watercress for home and market. The Department of Agriculture has prepared this publication as a means of answering the thousands of requests for information on the subject that are received annually.

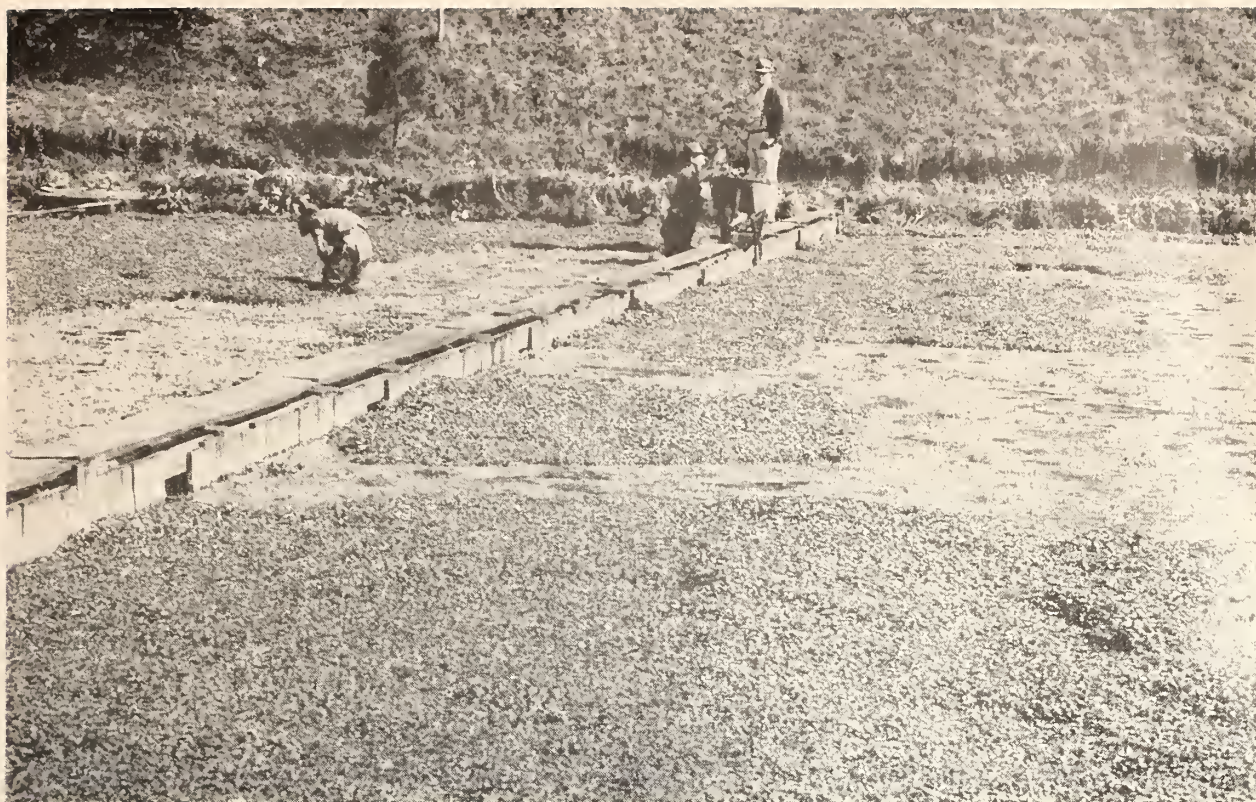


Figure 1.—Watercress beds at harvesttime. Note elevated walkways.

suitability of the water. Commercial laboratories can determine the nitrogen content of the water. A large flow of water is also needed to supply other nutrients and to protect the plants from freezing.

LOCATION AND CONSTRUCTION OF BEDS

Obviously, the best site for a watercress bed is on a relatively flat area with a slight slope below the spring that supplies the water. The beds should be protected from floods, which could cause severe damage to both the watercress and the beds. There should be enough slope to assure a constant flow of water and to permit complete drainage of the beds. The area where beds are to be located should be free of immovable rocks or rock outcrops. After grading, the foundation of the beds should remain firm enough when covered with water to afford good footing for workmen.

It is not practicable here to specify details of bed construction because each site, as well as individual circumstances, constitutes a different problem. Anyone contemplating a *substantial* commercial installation needs to gain first-hand knowledge of typical installations. He will prob-

ably need the services of an engineer and modern earth-moving equipment.

The size of an individual bed depends partly on the size of the enterprise to be developed and partly on the contours of the site. The shape of a bed also depends on the contours of the site.

The individual bed should be no larger than required to furnish the amount of watercress normally harvested in 2 or 3 days. A series of about a dozen beds is required to afford successive 2- or 3-day harvests for about a month, the time required for the plants to reach harvest stage again after a harvest has been completed.

Where the beds are to extend over an area that slopes more than 2 inches per 100 feet, construct a series of beds at successively lower levels to avoid excessive slope within individual beds and to avoid moving excessive amounts of earth in producing the desired grades of beds. Make the beds level in the direction at right angles to the direction of water flow. Slope them 2 inches per 100 feet in the direction of flow to permit effective drainage. If the land slopes appreciably at right angles to the flow the beds must be relatively narrow to avoid moving excessive amounts of earth in grading the bottoms. Sometimes the

beds are little more than wide, shallow ditches or canals through which the water flows from the spring or from a supply canal leading from the spring.

Make bypasses for all beds. This is essential for draining the beds. Bypasses are also needed to carry away surplus supply water, surface drainage, and flood water.

If the beds are less than 2 feet deep, construct dikes at the sides of the beds. Dikes may be made of earth. They should be several feet thick at the base. Dikes or dams between beds are best constructed of concrete or wood. Adjustable gates in the dikes between the beds permit effective control of the water. The gates consist of openings in the dams with slotted sides to hold strips of wood that fit into slots. The strips can be added or removed as the need for regulating the water arises.

The dikes are constructed so they can be used as walkways. In large beds additional walkways may be needed to facilitate the removal of the crop, which is generally hauled to the packing-house in wheelbarrows. Supplemental walkways can be constructed of planks supported on posts.

The bottom or floor of the bed must be of a character that will remain firm and free of appreciable settling after the water is turned in. The grade of the bottom must be maintained if the water over the bed is to be maintained at a reasonably uniform depth; and the bottom must afford a firm footing for workers in the beds. If the bottom tends to be too soft, gravel or crushed stone should be added to give firmness.

In preparation for the first planting, spread a layer of rich compost 2 to 4 inches deep over the bottoms of the beds. Work it smooth in much the same manner that garden soil is prepared for planting.

PLANTING

Watercress can be grown from either seed or cuttings. New plantings may be started from seed in a plant bed in early spring, if cuttings are not readily available. Small plants from the plant bed are transplanted to permanent beds and there produce growth from which cuttings can be made for planting additional beds. Once a bed is established further propagation is usually done with cuttings.

Watercress seed is very small. Broadcast it thinly over finely prepared compost. Then

lightly rake to barely cover the seed. Mixing the seed with several times its volume of dry sand aids in sowing it thinly. An ounce of seed sows about 70 square yards of plant bed. Properly handled, it produces about 70,000 plants, enough to transplant about 17,500 square feet of permanent bed if plants are spaced 6 inches apart each way.

Keep the plant bed moist but not covered with water. As the seedlings develop, let water into the bed, but not enough to cover them. Seedlings 2 to 3 inches tall are large enough to transplant. Seed is sometimes scarce or unobtainable from commercial seedsmen.

Cuttings are usually transplanted during the summer. They can be taken from either wild or cultivated plants, and from parts of the plant either above or below water level. Care is necessary to avoid carrying pests such as duckweed, snails, and sowbugs into the new bed with the cuttings. Cuttings from below water level are more likely to be infested with pests.

Seedlings and cuttings are usually transplanted about 6 inches apart each way. If plants or cuttings are scarce they may be planted as far apart as 1 foot each way. Close planting is preferred because it gives more uniform growth for the first harvest. Sufficient plants or cuttings should be available to finish planting an entire bed within a few days of the time planting is started. Use cuttings about a foot long.

Plants and cuttings transplanted within a single bed should be of as near uniform length as feasible. Set them firmly upright with 6 to 8 inches or more exposed. As soon as the transplants have started to grow vigorously, the tips of the new growth should be clipped to induce the development of short, stocky growth.

Set the seedlings or cuttings in water about 1 or 2 inches deep that is flowing slowly through the bed so as to supply fresh water without disturbing the newly set plants. Start planting at the lower end of a bed and proceed to the upper end, leaving a narrow unplanted band at the upper end to facilitate uniform distribution of water. Beds planted with seedlings or cuttings as described produce a crop by late summer or autumn.

BED MANAGEMENT

In new plantings harvesting can begin when the new growth is 6 to 8 inches long. Under favorable growing conditions harvests can be made

about a month apart. During cold weather, growth is slower. Immediately after harvest the stubble should be barely submerged. Clip back or push under any stubble above the water so that it stays under. Unless clippings shade the watercress plants excessively they can be left in the bed. Uneven stubble causes irregular growth since stubble above water is slow to start new growth.

If the water is raised to cover taller stubble, the shorter stubble may be covered too deeply and its growth retarded. As new growth develops, raise the water level gradually, leaving several inches of growth above the water. As successive crops are harvested the stubble becomes progressively higher and the water level is raised as necessary to cover it.

By late spring or early summer in the southern and middle parts of the country, respectively, market demand and crop quality tend to decrease so that harvesting is suspended. The beds are carefully weeded at the end of the spring harvesting. The plants are often allowed to go to seed after the early series of harvests, then in midsummer the water level is lowered to about 3 or 4 inches deep and tops of the plants are cut back to the water level. At this time cuttings are planted in any vacant spaces in the beds, and the beds are again weeded if necessary. Maintenance of a dense growth of watercress is one of the most effective ways to control weeds. This midsummer cutting back of the plants, the replanting and the cleanup of the beds prepare them for the production of late summer and autumn crops.

Little is known about the need for or the effective use of fertilizer in watercress beds. Some English growers add superphosphate to the compost in the beds, but there is no published evidence that this practice pays in the United States.

In regions of relatively mild winters, watercress is harvested throughout the winter. Winter crops bring the best prices, but the plants may need some protection from cold. Proper control of water level is the chief protection against cold injury. When the temperature becomes low enough to endanger the exposed portion of the plants, the crop is completely submerged. As soon as the temperature moderates, the water level should be lowered to expose the young growth, since submerged watercress grows very slowly.

So long as weeds, diseases, and insects, or other animals do not interfere with crop development there is no need to drain the beds for special treat-

ment before the plants become unproductive from age. Watercress, however, is by no means always free of pests.

YIELDS AND LIFE OF BEDS

Like the annual yields per unit area of all other crops, yields of watercress vary over a wide range. Yields vary among different districts and beds, and from year to year for the same beds. Average yields per cutting are about 2,500 bunches per 1,000 square feet of a well-established bed. Well-managed beds under favorable conditions in the middle and northern districts reach maximum production within a year after planting. They may continue relatively high in production indefinitely if properly cared for. The need for regrading or a heavy infestation of plant or animal pests may necessitate renewal of beds.

WEEDS

Various algae, which are low forms of plant life, are commonly present in watercress beds. They become most troublesome when the water is warm. Algae compete with the watercress for nutrients in the water. They are most injurious, however, when they form stringy or spongy masses of "moss" that contaminate the harvested product and that impart a fishy odor to the water and to the watercress. Adding copper sulphate to the water at 2 to 10 parts per million will kill most algae without undesirable effect on the crop. One pound of copper sulphate in 25,000 gallons of water (about an acre-inch) gives 5 parts per million. A small cloth bag of the crystals placed in the water inlet of a contaminated bed is a good way to apply it. Maintaining a heavy, uniform growth of watercress discourages development of algae by deeply shading the water.

Duckweed (*Lemna*) is a common pest. It is a tiny water plant that floats at the water surface. Sometimes it covers the water so densely as to smother the new growth of the submerged watercress following a harvest. Duckweed also floats in among the stems of new growth and clings to shoots when they are harvested, impairing the market quality of the product.

Duckweed is difficult to eliminate. Its numbers can be reduced after harvest by raising the water level well above the watercress stubble to float the weeds off and down the drainage channel. Spraying the weedy water surface with a saturated solution of copper sulphate at this time also may



Figure 2.—Bed damaged by sowbugs. Stakes are driven through masses of dislodged plants to hold them in place.

help but neither method will eliminate all the duckweed: enough usually remains to reinfest the beds. If the infestation cannot be controlled by these methods it may be necessary to drain the bed, clean out all the vegetation and allow the soil to dry. This last procedure is of course expensive but it also affords opportunity to clean up other pests, both plant and animal.

Water speedwell is a larger weed that has opposite oval leaves and spikes of blue flowers. The seeds may persist for years in the bottom of a bed, ready to grow when favorable conditions arise. The only practical control is to maintain a good stand of watercress and to weed the beds regularly. Extreme care should be exercised to prevent this or other water weeds from producing seed either in or around watercress beds.

ANIMAL PESTS

Many small forms of animal life such as various worms, leeches, larvae, fairy shrimp and crayfish commonly inhabit watercress beds without injuring the plants. These creatures, however, impair the market value of the watercress if they are found in the harvested product.

Some species of snails feed on watercress but rarely cause appreciable damage. Presence of snails on harvested product impairs its market value. They can be effectively controlled by draining and drying out infested beds.

The watercress sowbug, a serious pest in the Shenandoah Valley of Virginia, has caused the abandonment of many beds. It eats the underwater leaves of the watercress and chews through the stems, setting masses of plants adrift in the beds. Where this pest is serious, stakes are commonly driven through masses of detached plants to hold them in place (fig. 2). The watercress sowbug spends much of the time in the mud of the bottom of the beds. Usually only a few are visible at any one time, although large numbers may be present.

Sowbugs must have water in which to live. Draining and drying the beds either kills them or forces them to migrate into the bypass. Those moving into the bypass can be killed by spraying them with a mixture of 3 parts of ethylene dichloride and 1 part of carbon tetrachloride. A small amount of an emulsifying agent, such as a liquid

household detergent, must be added to this mixture. The detergent causes the spray droplets, which are heavier than water, to remain separate while they settle to the bottom of the ditch. The mixture is sprayed into the ditch at the rate of 1 pint per 400 square feet of water surface. Thus, if the water surface in the ditch is 3 feet wide, 1 pint of the mixture should be applied per 133 linear feet of ditch.

Aphids, leaf beetles and leafhoppers sometimes attack watercress. These insects can be controlled by spraying the plants with malathion, using 4 pounds of 25-percent malathion wettable powder per 100 gallons of water. This quantity is sufficient to treat 1 acre. For small areas use 3 level tablespoons of the powder per gallon of water. Do not apply malathion to watercress within 7 days before a harvest.

CAUTION.—Ethylene dichloride, carbon tetrachloride, and malathion are poisonous. Handle them with care. Follow the directions and heed all precautions on the container label.

Muskrats are generally a serious pest. They make runways through the plants in the beds and eat the plants when other food is scarce. They do the greatest damage, however, by burrowing into the dikes, thus making it difficult to main-

tain a uniform flow and depth of water in the beds. Continual trapping may be necessary to keep them under control.

DISEASES

Watercress in the United States has not been found to be damaged seriously by diseases. *Cercospora* leafspot sometimes attacks it, however, first appearing on the older leaves as dirty-white spots that enlarge rapidly, killing the leaf. In beds that are well managed this disease is not known to be troublesome.

Two serious diseases of watercress occur in Great Britain and may eventually be found elsewhere. One is a virus disease that causes a yellow-green mosaic or ring spotting accompanied by stunting and eventual death of the plant. This disease is spread by aphids and affects a number of different kinds of plants. The other disease, called crook root, is a fungus disease that results in the production of chlorotic young leaves whose margins curl under. The base of the stem may rot off and roots developing on the stems are short, swollen, curved and brittle.

HARVESTING AND PACKING

Harvesting and marketing of watercress must be done carefully and rapidly because the product is highly perishable. Harvesting, packing, and shipping must be effectively scheduled to insure that no more watercress is harvested than can properly be packed and shipped the day it is harvested.

The workers who harvest the commercial crop wear hip boots, carry a bundle of short lengths of twine for tying the bunches, and a long, sharp knife (fig. 3). The tops of the plants are cut by the handful about 6 inches below the tips and are gathered into bunches as they are cut. The bunch is tied close to the top, and the butt is trimmed smooth to give a bunch about 4 inches tall (fig. 4). The bunches are then placed in the water near an elevated walk or dike. They are put into wheelbarrows for hauling to the packing shed, which is usually adjacent to the beds, or to trucks that carry them to a packing shed. Sometimes the cutter puts the bunches directly into tubs that are used for carrying the watercress to the packing shed. For long hauls from the beds to the packing house the watercress is precooled in a mixture of ice and water before loading.



Figure 3.—Harvesters wear hip boots and cut the watercress with a large knife.



Figure 4.—Trimming the bunch to desired length. Note strings at harvester's belt for tying the bunches.

Various shipping containers are used such as apple barrels holding 300 bunches, orange crates holding 150 bunches, and baskets or crates holding 100 bunches.

Containers are lined with parchment paper and the layers of watercress alternate with layers of crushed ice. The amount of ice required depends on the outdoor temperature and on the distance to market. The use of plastic bags containing one or two bunches extends the display life of the watercress.

GROWING WATERCRESS FOR HOME USE

A few plants covering a few square feet will produce enough watercress to supply the average family. It can be grown with little effort if a suitable spring or brook, however small, is conveniently near the house. Where clean shallow water flows gently over soil, it is only neces-

sary to push the basal ends of a few cuttings into the wet soil and let the plants grow. Little soil is needed. In spots too rocky or gravelly for planting cuttings or seedlings, a small bed of soil can be prepared in a submerged shallow container. Yields per unit area may be rather low under such "wild" conditions but still ample for home use.

When the plants become too rank, or develop an unthrifty appearance, about $\frac{1}{2}$ to $\frac{2}{3}$ of their length should be trimmed off to stimulate fresh, succulent growth.

Where no spring or brook is available, watercress for home use can be grown in a small spot in the garden, or in a cold frame, that is kept constantly wet by a small trickle of irrigation water on the soil surface. Such a spot for watercress should be located where the water applied will not harm other plants.

This leaflet supersedes Leaflet 134, Production of Water Cress. Illustrations in this leaflet are by courtesy of Virginia Agricultural Experiment Station.

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